WE CLAIM:

1. An optical device to receive an input optical signal having one or more wavelengths, said device comprising:

(a) a beam distribution element to receive the input optical signal and distribute it into a plurality of beams;

(b) a variable path length element to receive the plurality of beams from the beam distribution element, wherein the variable path length element comprises a plurality of path sections, wherein a length of at least one of said path sections is variable; and

(c) a beam interaction element to receive the plurality of beams from the variable path length element,

wherein the plurality of beams interact in the beam interaction element.

2. The optical device according to claim 1, further comprising:

a plurality of exit ports to receive the interacted beams from the beam interaction element,

wherein a first exit port receives a first demultiplexed optical signal having a first wavelength and a second exit port receives a second demultiplexed optical signal having a second wavelength different from the first wavelength.

3. The optical device according to claim 2, further comprising:

a controller operatively coupled to the variable path length element to vary the length of the at least one of said path sections.

4. The optical device according to claim 3, wherein a first path section is set to a first physical path length by the controller and a second path section is set to a second physical path length by the controller, wherein the first physical path length is different from the second physical path length.

5. The optical device according to claim 3, wherein the variable path length element comprises an optical switch fabric.

6. The optical device according to claim 3, wherein the variable path length element comprises a two dimensional optical switch fabric.

7. The optical device according to claim 6, wherein a first path section comprises a first plurality of MEMS mirrors, and

wherein, when actuated, at least one of the first plurality of mirrors is disposed in a first optical beam path to increase the total physical path length traversed by a first optical signal.

8. The optical device according to claim 7, wherein the mirrors of the first plurality of MEMS mirrors are spaced from each other by a given distance, such that nearest neighbor mirrors are spaced apart by a same distance *d*.

9. The optical device according to claim 8, wherein the first path section imparts a first delay on the first beam proportional to *d* and a second path section imparts a second delay on a second light beam from the distributed beams proportional to k*d*, where k is an integer value.

10. The optical device according to claim 8, wherein the first path section is controllably adjustable to impart a first or second delay on the first light beam proportional to *d*, wherein the first and second delays are different.

11. The optical device according to claim 7, further comprising:

a receiving waveguide coupling the variable path length element to the second optical element,

wherein at least one of said first plurality of cantilevered mirrors controls an intensity of the first light beam reflected from said at least one cantilevered mirror into the receiving waveguide.

12. The optical device according to claim 7, wherein at least one of the first plurality of MEMS mirrors is partially actuatable.

13. The optical device according to claim 1, wherein the first optical element is a star coupler.

14. The optical device according to claim 1, wherein the beam distribution element is a planar waveguide slab.

15. The optical device according to claim 1, further comprising:

a first coupling structure optically connecting the beam distribution element to the variable path length element; and

a second coupling structure optically connecting the beam interaction element to the variable path length element.

16. The optical device according to claim 15, wherein the first coupling structure is a plurality of waveguides corresponding to a number of path sections of the variable path length element.

17. The optical device according to claim 15, wherein the first coupling structure is a monolithic structure.

18. The optical device according to claim 15, wherein the first coupling structure comprises a plurality of optical fibers.

19. The optical device according to claim 1, wherein the variable path length element comprises a first liquid crystal crossconnect device comprising one or more liquid crystal switches to reflect a first incident beam from the distributed beams, such that, when actuated, said liquid crystal switches increase the length of a first optical beam path.

20. The optical device of claim 1, wherein the variable path length element includes a plurality of switching elements, and

wherein at least one of the switching elements controls an intensity of a light beam received by the beam interaction element.

21. The optical device according to claim 1, wherein the variable path length element comprises a three dimensional switching structure to impart an incremental path length difference in free space.

22. The optical device according to claim 21, wherein the three dimensional switching structure comprises a first moveable mirror array and a second moveable mirror array.

23. The optical device according to claim 22, wherein the first and second moveable mirror arrays are disposed facing one another.

24. The optical device according to claim 21, wherein the three dimensional switching structure comprises an array of at least two parallel two dimensional MEMS switch arrays.

25. The optical device according to claim 1, wherein the variable path length element comprises a first bubble-based optical switch device comprising one or more bubble-based switches to reflect a first incident beam from the distributed beams, such that, when actuated, said bubble-based switches increase the length of a first optical beam path.

26. The optical device according to claim 1, wherein the variable path length element comprises a first Mach-Zehnder interferometer (MZI) switch fabric comprising one or more MZI switches to direct a first incident beam to one of two arms, such that when actuated, said MZI switches increase the length of a first optical beam path.

27. An optical device for multiplexing/demultiplexing an optical signal, comprising:

(a) an input waveguide comprising a first end and second end;

(b) a beam distribution element to receive the optical signal emanating from the second end of the input waveguide and to distribute optical signal in more than one dimension;

(c) a variable path length element to receive first and second beams of the distributed optical signal, wherein the variable path length element comprises a plurality of path sections,

wherein a length of at least one of said path sections is variable,

wherein the first beam propagates along a first path section and the second beam propagates along a second path section,

wherein the first path section is set to a first path length in a first state and the first path section is set to a second path length in a second state, and

wherein the first and second path lengths are different.

28. The optical device according to claim 27, further comprising:

(a) a first lens to collimate the first beam of the distributed optical signal and to direct the first beam along the first path section;

(b) a second lens to collimate the second beam of the distributed optical signal and to direct the second beam along the second path section; and

(c) a third lens to focus an output of the variable path length element.

29. The optical device according to claim 27, further comprising:

(a) a first coupling structure optically connecting the beam distribution element to an input of the variable path length element; and

(b) a second coupling structure optically connecting the variable path length element to the beam interaction element, which separates a first wavelength component from the optical signal and directs the first wavelength component to a first output port and that separates a second wavelength component of the first beam and directs the second wavelength component to a second output port.

30. The optical device according to claim 29, wherein:

(a) the first coupling structure comprises a first plurality of m waveguides, wherein each of said first plurality of m waveguides is coupled to a different path section of the variable path length element; and

(b) the second coupling structure comprises a second plurality of m waveguides, wherein each of said second plurality of m waveguides is coupled to an output of a different path section.

31. A method of demultiplexing a multiplexed optical signal, comprising:

(a) distributing the optical signal into a plurality of beams;

(b) directing the plurality of beams to a variable path length element,

wherein the variable path length element comprises a plurality of path sections corresponding to a number of distributed beams,

wherein a first beam of the plurality of beams propagates along a first path section and a second beam of the plurality of beams propagates along a second path section,

wherein the first path section is set to a first path length in a first state and the first path section is set to a second path length in a second state, wherein the first and second path lengths are different, and

wherein the second path section is set to a third path length in a first state and the second path section is set to a fourth path length in a second state, wherein the third and fourth path lengths are different; and

(c) directing the first and second beams from the variable path length element into a beam interaction element,

wherein a first exit port of the beam interaction element receives a first output beam having a first wavelength and a second exit port of the beam interaction element receives a second output beam having a second wavelength, said first and second wavelengths being different.

32. The method according to claim 31, further comprising:

providing an incremental path length difference for each of said plurality of path sections.

33. The method according to claim 31, further comprising:

instructing the variable path length element to change from the first state to the second state.

34. The method according to claim 31, further comprising:

attenuating an intensity of the first beam.